GAS JOURNAL, JAN. 23, 1946

VOL. 247 98th YEAR No. 4314

## THE DESIGN OF REGENERATORS

ALTHOUGH regenerators are not used to any great extent, if at all, in the Gas Industry, they are the almost universal method of waste heat recovery in the by-product coke oven. Earlier by-product coke ovens, like beehive ovens, recovered their waste heat—if at all—by means of waste heat boilers. These boilers were nothing more than normal Lancashire boilers through which were passed the hot gases collected from the whole battery. Regenerators, invented and applied to the steel furnace by Siemens, were used in coke ovens about the year 1883. These regenerators were long chambers, filled with chequer brickwork, and running from one end of the battery to the other. The volume of brickwork per oven was not very great, and the distribution of waste gas and air over the regenerator was largely left to chance. About the year 1900 the late Dr. Koppers placed the regenerators under the oven chamber, and gave each oven its own separate regenerator, thus initiating modern practice. For long, no particular progress was made in regenerator design; improvements were made in the situation of the regenerators, but so long as they were adequately filled with brickwork, and the chequer bricks were placed so as to equalize the resistance to gas flow at various parts of the chamber, the arrangement was deemed to be satisfactory. In steel furnaces, and indeed in most other furnaces, the problem was to prevent the regenerator from becoming blocked by dust carried in the gases, and thermal efficiency had to be sacrificed in the interest of keeping the plant in operation. Coke ovens were unique in operating on clean gas, though until suitable cleaning methods were available there was trouble with dust carried in blast furnace gas.

The attempts made to work out a theory of heat transfer in regenerators were handicapped by the fact that the necessary data did not exist, since published figures referred for the most part to regenerators working on dusty gas. The many attempts to work out a mathematical theory were thus not very successful, and Trinks, in his well-known book on furnace design, has remarked that there is no complete and exhaustive treatise on regenerators in the English language. He has further added that there is not likely to be one in the near future because of the number of variables to be taken into account. He has in fact listed 17 of them. When theory fails to give an answer, experiment must be the mother of invention. That was the method used by the Woodall-Duckham Company, and the result of the investigations made on this subject has been lately described in a Paper to the Institute of Fuel by T. C. Finlayson and A. Taylor, which was summarized in the "JOURNAL" of Jan. 2 (page 22). This series of experiments was comprehensive, and occupied some two years. It represents a work of considerable magnitude, but one which has clearly proved well worth doing. The results will be used as a mine of information for many years to come by those investigating the subject theoretically.

Perhaps the outstanding theoretical Paper in English on this very difficult subject is that contributed by Rummel to the Institute of Fuel in 1930, and in some respects the present experimental studies follow this earlier discussion, and extend it by showing experimentally what is the truth of various aspects of the problem which were in doubt. One doubt that arises in our mind is that of the efficiency of the regenerator. The generally accepted measure of the efficiency is the degree to which the air is pre-heated. The waste gases flowing down the regenerator give heat to the brickwork. The incoming air takes up a proportion of that heat, while the remainder escapes in various ways and is lost to the system. When stable conditions are set up the heat abstracted from the flue gases must be equal to the heat taken up by the air plus the losses, otherwise the regenerator temperature cycle would not be stable. The efficiency of the regenerator is determined by the percentage of the heat lost by the waste gases that is taken up by the air. That is broadly the meaning of "the efficiency of the regenerator." It is not strictly the same definition as that given by the Authors, who state it as the ratio of the actual heat in the hot air to that which would be contained in the air if it attained the same temperature of the incoming hot waste gases—the maximum temperature that the air could attain. But is it right fundamentally to consider this efficiency only? From the point of view of the authors it is right, for they have investigated the efficiency of the regenerator as a unit. From the fuel efficiency aspect, should not the emphasis be on the heat content of the flue gases? There is a certain quantity of heat escaping in the waste gases; what the furnace operator and designer wants to know is how much of this heat can be extracted and put to useful purpose. The usual efficiency formula does not tell us this, except by inference. The inference is that if the air starting from the cold is not pre-heated to somewhere near the temperature of the incoming gases, the waste gases cannot have been cooled sufficiently to extract the necessary heat from them.

## LIMITING FACTORS

THERE is a limit on economic grounds to the extent to which heat can be extracted by regeneration since, as the temperature of the waste gases falls, the transfer of heat becomes slower. Has the idea been tried of combining regenerators with metal recuperators? The answer to this speculation is that the present coke oven regenerator succeeds in cooling the gases to about 250°C., and cooling below this temperature is not likely to result in saving much heat. The chimney needs a certain amount of heat for its operation. Chimneys are in fact quite an expensive way of producing draught, if the heat content of the gases necessary for their operation is compared with the heat required to generate power for the operation of a waste gas fan. It is, however, a curious commentary on differing points of view that whereas the boiler designer strives to reduce the temperature of his outgoing flue gases to something of the order of 300°F., and makes use of expensive economizers, air heaters and other heat exchange plant in order to do so, the furnace designer is content to allow double or treble the heat escape without turning a hair. Is not the heat content of producer gas or coke oven gas at least as valuable as that of boiler fuel? Why should it, in one type of industrial plant, be considered satisfactory to let 15% or so of the heat in the fuel escape, whereas in another type, using cheaper fuel, only 10% is allowed to escape? We ask the question in all seriousness, knowing full well that most boilers are not as efficient as all that. That, however, is not the fault of the boiler designer.

One marked difference between the regenerator and the recuperator lies in the effect of the thermal conductivity of the material. When heat is being abstracted in a recuperator the size of the recuperator depends considerably on the thermal conductivity of the material through which the heat has to pass. Thus it is that metallic recuperators, which were discussed in the "JOURNAL" of Jan. 9, have a marked advantage

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over brick recuperators apart altogether from the leakage factor. It was for long believed that the thermal conductivity of the brick used in regenerators would have a similar effect, because the heat would have to be conducted into and out of the brick during each cycle of the regenerator. The present Paper convincingly disproves this supposition, and shows that there is not much scope for improvements in the properties of the bricks. It would appear that the heat does not penetrate very deeply into the brick, and that the rate of heat transfer from brick to air by convection, or from waste gas to brick by the same method, is always less than that of the conduction of heat through the outer ¼-in. or so of brick surface.

This Paper will require and will no doubt receive the most careful consideration from the designers of coke ovens and furnaces where regenerators are used. In our comments here and in the summary published on Jan. 2, it has been impossible to do more than to touch upon some of the very many points of interest and indeed of importance which have been raised by this study. Whether regenerators will ever be used to any extent in gas-works practice we do not know, and indeed to answer that question, we should be compelled to ask whether in the new Gas Industry as visualized by the Heyworth Report it will be found that carbonization in bulk in coke ovens will play a much greater part in the manufacture of gas in the future than it has done in the past. Although there is no immediate application of this work to the Gas Industry therefore, let no gas engineer who has not read this Paper salve his conscience by reflecting comfortably that it can never concern him.

## APPLIED EFFICIENCY

WE have been impressed by a series of articles which appeared in *The Times* recently on the relationship between the Government and Industry. In the first of this series it was stated that the air of simplicity which has become attached to the term "efficiency" can be misleading, and that the commonest confusion is to conceive efficiency exclusively as technical efficiency in carrying out a specific task. South Wales produces 40 million tons of coal a year. What will this mean 50 years hence? The reason why we were particularly interested in the series of articles was because so much of the bulk of the matter related to industries of considerable tradition, among which the Gas Industry counts itself, and the query was raised as to how far and how fast could an old industry—and this again is a relative term—take advantage of modern methods and changed raw material conditions, and, to quote the article, "to free itself from the strait waistcoat."

In common with many other industries the Gas Industry, through war conditions, has suffered from neglect of due repair and maintenance of plant, and it has to encounter an unhappy labour position. In the articles in question reference was made to the steel industry, and again queries were asked as to how much in fact had been accomplished. Yet even the neglect of plant maintenance may be turned to advantage, since the case for putting in thoroughly modern equipment instead of patching up old equipment is strengthened as the cost of patching grows.

At the moment the Gas Industry's chief bottleneck—and we are very tired of hearing every few seconds in ordinary conversation that the bottleneck is this or that—is the problem of labour. It will also have to continue to regard seriously the encouragement of collective research so that it neither stifles emulation nor becomes the enemy of small beginnings. The Industry must, in fact, be capable of visualizing an economic strategy for industrial research. And once again we quote from the series of articles mentioned: "the measure of success which the Government achieves in promoting efficiency by control of investment or by direct investment will depend almost wholly on their skill in selecting experts." It is obvious, too, that the danger of inertia and resistance to change will not be banished by the advent of public ownership, just as it is obvious that successful democratic action cannot be based on the conventional handouts of trade associations and Government Departments.

## The Gas Fund

In the Gas Fund (Contribution) Order, 1946, dated Jan. 2, the Minister of Fuel and Power in pursuance of the powers conferred upon him by Section 7 of the Gas Regulation Act, 1920, as amended by the Gas Undertakings Act, 1934, prescribes that the rate of contribution to the Fund for the year 1946 shall be: (*a*) ten pence for each five thousand therms in the form of gas sold during the year 1945 (excluding gas sold to other undertakers in bulk for distribution and gas supplied separately for industrial purposes only); and (*b*) five pence for each five thousand therms in the form of gas supplied separately for industrial purposes only during the year 1945. Such contribution shall be paid on or before April 1, to the Minister of Fuel and Power at Heyhouses Lane, Lytham St. Annes, by all gas undertakers with respect to whom an Order under the Gas Regulation Act, 1920, shall have been made or to whom subsection (3) of section 7 of that Act applies by virtue of any public general Act, Special Act or Special Order.

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## Personal

Mr. J. H. KINNON, Helensburgh, has been appointed Assistant Manager of Dunfermline Gas Department.

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Mr. C. T. PRICE, Engineer and General Manager of the Hampton Court Gas Company, has been appointed to a seat on the Board of that Company.

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Mr. R. KELF-COHEN, Principal Assistant Secretary in the Ministry of Fuel and Power, has been appointed an Under-Secretary. He remains in charge of the Gas and Electricity Division.

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Mr. J. OLDROYD, who has been Assistant to the Secretary of the Newcastle-on-Tyne and Gateshead Gas Company, has been appointed Assistant Secretary of the Croydon Gas Company.

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Mr. H. H. HOLLIS, Chairman and Managing Director of Oxley Engineering Co., Ltd., Leeds, has now made a good recovery from his serious illness, and is able to give part-time attention to business matters.

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Mr. JAMES PARKER, Coke Salesman and in charge of general transport arrangements of the Leamington Priors Gas Company, has been awarded the M.B.E. for his services as Sub-District Manager of emergency road transport in the Coventry area.

* * *

Mr. FRANK H. ROBINSON, Engineer and Manager of the Bishop's Stortford, Epping and District Gas Company, will retire on Jan. 31, and is returning to Harrogate to reside. His successor as Engineer and Manager will be Mr. H. I. WRIGHT, Assistant Engineer of the Company.

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Mr. ROBERT FOOT, Chairman of the Mining Association, has been appointed Chairman also of the Council of the British Coal Utilization Research Association in the place of Mr. H. M. LINDARS, who has held that position since the formation of B.C.U.R.A., but has resigned owing to the pressure of other claims on his time.

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Mr. JAMES M. DOW, Engineer and Manager of Kirkcaldy Gas Department, has been appointed Engineer and Manager of the Paisley Gas Department, in succession to Mr. SYDNEY SMITH, who has accepted the post of General Manager and Engineer of the Romford Gas Company. A native of Perth, Mr. Dow was formerly technical assistant at Perth Gas Department.

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Mr. JAMES MACPHERSON, who received his training at Perth Gas Department, has been appointed Engineer and Manager of the Linlithgow Gas Light Company. Educated at Perth and Dundee Technical College, he was appointed Assistant Engineer and Manager to Stirling Gas Light Company in 1943. He succeeds Mr. P. M'DOUGALL, who has been appointed to a similar position at Nairn.

* * *

Mr. JACK C. BRITTON, son of Mr. A. B. BRITTON, Engineer and Manage rof Hinckley Gas Department, has been appointed Deputy Gas Engineer and General Manager of the Hereford Gas Department. An old boy of Hinckley Grammar School and Leicester College of Technology, he was a pupil of his father at Hinckley, and later had experience with Newton, Chambers & Co., Ltd., of Sheffield. He takes up his new duties in March.

In the past six years the service given by the British people to their country has been recognized by the world, but little has been said of the men and women who have concurrently given service in their work to their firms. An outstanding example of such loyal service is of ten men, all of whom have completed half a century with the Davis Gas Stove Co., Ltd. On the administrative side, Mr. E. H. FIELD, Mr. A. T. PIERCY, Mr. J. A. STERNE, and Mr. J. T. TURNBULL are still actively engaged with the firm. On the works side, Mr. J. KING and Mr. W. TURNER are busy in the works at Luton. On the retired list are Mr. F. S. DAVIES (1938), Mr. H. SHAW (1943) and Mr. G. LARGE (1945). Mr. CYRIL G. DAVIS, Chairman of the Company, will also complete 50 years with the Company in March.

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Mr. L. VAN DE VELDE recently joined De La Rue Gas Development, Ltd. After studying in Economics at Antwerp in 1930 he was appointed to a post with the Fairey Aviation Company, in the carrying out of which his duties involved a great deal of foreign travel. Leaving Fairey's in 1934 he became assistant to the late Dr. Bernard Friedman and his personal collaborator in the sphere of Public Relations and Sales Promotion, implementing Dr. Friedman's policy, which was so largely responsible in securing the recognition of gas in the sphere of instantaneous water heating. The appointment of a sales executive conversant with the high standard of service due to the supply side of the Gas Industry from appliance manufacturers is indicative of the stage now reached by technical development work; and while Mr. Van de Velde's appointment is in the nature of a return to a tradition, his activities in the Gas Industry's service will be wider than hitherto. He will be located at the London Head Office of De La Rue, Imperial House, 84/86, Regent Street, 'Phone Regent 2901.

## Obituary

The death is announced of Mr. R. H. BRIGGS, M.B.E., who during the war was Assistant Director of the Technical Press Censorship. It was to Mr. Briggs that we had to submit much of the information published in the "JOURNAL" during the war years, and he was always helpful and willing to interpret the rules as leniently as possible, consistent with security. At the time of his death he was Editor of the *Overseas Engineer*.

## Letters to the Editor

### Presentation to Mr. W. J. Smith

SIR,—As you have recorded, Mr. W. J. Smith, M.B.E., F.C.I.S., acting upon medical advice, has resigned the Acting Secretaryship of the British Gas Council and the offices which he holds in other bodies connected with the Gas Industry.

The Council accepted the resignation of Mr. Smith with regret, and paid tribute to the outstanding work which he has successfully performed during the past 30 years. Appreciation was expressed of the help which he, at all times, so readily gave to those who personally sought his assistance.

The members of the Council decided to acknowledge such devotion and ability by making a presentation, in some acceptable form, to Mr. Smith. Since it has been suggested that others might wish to be associated with the presentation, I ask the hospitality of your columns to say that contributions to the fund, not exceeding one guinea each, should be sent to me at 1, Grosvenor Place, London, S.W. 1.

Yours faithfully,
J. R. W. ALEXANDER,
*General Manager, British Gas Council.*

### Use of the Wobbe Index

DEAR SIR,—The gas quality proposals of the Heyworth Report are obviously intended to ensure that on a governed gas supply the thermal output from a certain orifice will be constant. May I suggest that the same result may be obtained without adding so much to the difficulties of gas manufacture by using the Wobbe Index (calorific value divided by the square root of the gravity)? If C.W. gas is used to meet peak demands (a practice referred to without condemnation in Paragraphs 95 and 212 of the Report), it is not easy to keep the S.G. within $\pm$ 5%.

On a gas of C.V. 500, S.G. 0.5 (Wobbe Index 707), the prescribed limits give a variation of Wobbe Index from 669 to 747, approximately $\pm$ 5½%, so that if a gas undertaking maintained a Wobbe Index of 700 $\pm$ 5% the calorific value at any particular time would need to be 700 $\times$ $\sqrt{\text{S.G.}}$, $\pm$ 5%. This would mean that when more C.W. gas is made, the C.V. would be raised—an uneconomic procedure, but one already adopted by undertakings who try to keep their A.T.B. number within reasonable limits; indeed one could say "Look after Wobbe and the Aeration Test Burner will look after itself."

Finally, to give the Industry greater flexibility, I see no reason why the declared calorific value should not be abolished, retaining the thermal basis of charge, and using in each quarter the official average C.V. obtained in the corresponding quarter of the previous year.

Yours faithfully,
C. HAYES.

## Peak Sales at Rotherham

The report and accounts of the Rotherham Gas Department for the year ended Mar. 31, 1945, just issued, record that gas sales reached a peak of 2,260 million cu.ft. in 1943–44 and fell to 2,178 million cu.ft. in the year under review, the 3.6% decrease being attributed to the effects of national fuel economy in industry. The maximum day's output of 8,844,000 cu.ft. on Jan. 23 was the highest ever recorded.

Recalling wartime experiences, Mr. W. H. T. Johns, Engineer and General Manager (who has since been appointed to Warrington), states that the closing down of the waterless holder on Government instructions was a severe handicap, depriving the Department of two million cu.ft. storage which was vitally necessary at that time owing to the big industrial demand for essential war production. The Department had to deal with daily send-outs of over eight million cu.ft. with a workable storage of under two million. Difficulties were aggravated by air-raid warnings, resulting in curtailed supplies from coke ovens of inferior quality gas. Early in the war there was an accident to the water gas relief holder and the plant could not be worked without it. Some damage was sustained on two occasions on the distribution side, and in the Sheffield raids the crowns of the holders were slightly pierced by shrapnel.

## Heating of Homes

The heating and ventilation of dwellings is the subject of a report by the Heating and Ventilation (Reconstruction) Committee of the Building Research Board of the Department of Scientific and Industrial Research, published on Monday last. It is No. 19 of the Post-War Building Studies, and is published by the Stationery Office, price 2s. 6d. (2s. 10d. post free).

The Committee, of which Sir Alfred Egerton is Chairman and Sir Ernest Simon Vice-Chairman, has, in spite of the complexity of the subject, been able to reach a large measure of agreement. Two of the more important recommendations concerning the desirable conditions are that means should be provided for maintaining a measure of warmth throughout a dwelling even at night, and for giving an adequate supply of hot water.

The average consumption a house in this country before the war was considerably more than in Germany, and very little less than in America. Against this most people would agree that our homes were not, on an average, appreciably warmer than German homes, and they were certainly very much less warm than the American. This technical backwardness may have been due in part to the abundance of cheap coal in Britain, with the result that there has been little incentive to the economical use of coal.

In view of the national importance of the right use of coal, says the report, it is not sufficient to leave the whole choice of methods of heating to haphazard development. A planned policy, national in scope, is desirable in order that the industries concerned may direct their efforts into the right channels, and be enabled to organize themselves to meet the programme ahead.

A much improved standard of thermal insulation is recommended, not only because of the economy in fuel, but also on account of the greater comfort.

The problem of atmospheric pollution by the smoke from domestic appliances (the source of about half the smoke in the air) is considered in some detail. Results of an extensive social survey of the heating of dwellings at the present time are given in a long appendix.

## Diary

Jan. 26.—Manchester and District Junior Gas Association: Paper, "The Application of Laboratory Tests to Works Control," C. Whitehead (Preston), 3 p.m.; Annual Dinner and Social Evening, 5 p.m., Engineers' Club, Manchester.

Jan. 26.—Midland Junior Gas Association: Visit to Incandescent Heat Co., Ltd., Smethwick.

Jan. 29.—Southern Association of Gas Engineers and Managers (Eastern District): Paper, "Gas Charges, with Special Reference to Tariffs," A. Tennant (East Surrey Gas Company), Gas Industry House, 2.30 p.m.

Feb. 2.—Scottish Junior Gas Association: Joint Meeting, Edinburgh. Paper by W. Boden, Stanton Ironworks Co., Ltd.

Feb. 6.—Institute of Fuel: Paper, "The Utilization of Waste Heat in Metallurgical Furnaces," E. C. Evans, Institution of Mechanical Engineers, S.W.1, 6 p.m.

Feb. 7.—Midland Junior Gas Association: "Six Years of Production Problems, Investigations, and Results," A. E. West, Birmingham Gas Department, 6.30 p.m.

Feb. 8.—London and Southern District Junior Gas Association: "Further Distribution at Tottenham," E. O. Rose, Gas Industry House, 7 p.m.

Feb. 12.—British Gas Council: Gas Industry House, 2.15 p.m.

Feb. 13.—B.G.C. Domestic Development Committee, Gas Industry House, 10.30 a.m.

## Safety in Industry

Changes in the industrial service provided by the Royal Society for the Prevention of Accidents are to have effect in April. This is due to the ending of the arrangement made with the Ministry of Labour and National Service in 1940, by which a free war-time basic service of accident prevention material was supplied to several thousand firms engaged on war work. Under the new arrangement, the industrial side of the Society will revert to a membership basis, though it will continue to work in the closest touch with the Government. Service will be provided on a co-operative, non-profit-making basis.

A new membership scheme will replace the earlier one in operation up to 1940. It has been so designed that membership service fees will cover the cost of the Society's staff and overhead expenses, and of a basic service to members. This method will enable the Society to provide additional material, such as posters and bulletins, according to the needs of individual works and at little more than the cost of printing and distribution. Notice of the change has been given to industrial undertakings in a circular signed by Lord McGowan (President), Mr. Wallace B. Phillips (Chairman, National Executive Committee), and Lt.-Col. J. A. A. Pickard (General Secretary).

## Copper Development Association

Full-scale activity is to be resumed by the Copper Development Association. A new feature of this activity will be the establishment of a workshop at the Association's new centre at Kendals Hall, Radlett, Herts, at which experimental work will be carried out. The annual report just issued refers to the special attention given to the use of copper tubes for plumbing purposes, and to other uses of copper in building, including flashings and weatherings, roofing, damp-proof courses, wall ties and rainwater goods. In connexion with roofing, a considerable amount of work was undertaken with a view to developing a labour-saving, light-weight copper roof for low-cost housing. Satisfactory progress has been made but the work has not yet been completed. Prizes continue to be given for the best work by students taking courses of copper work in technical colleges and schools.

The report comments on the great variety of engineering and industrial applications of copper and copper alloys. "It is enormously greater," it states, "than could be envisaged as a result of individual experience." The Association's work in this field is stated to comprise phases of metallurgical work, production, chemical and general engineering, transportation and industrial processes of all kinds.

The Hon. R. M. Preston, D.S.O., Managing Director Rio Tinto Co., Ltd., has been appointed Chairman of the Council, and Mr. S. S. Taylor, C.M.G., D.S.O., Managing Director, Rhokana Corporation, Ltd., Vice-Chairman.

## Training for Fuel Technologists

"The Training of the Fuel Technologist" was the title of a paper read before the East Midland Section of the Institute of Fuel by Dr. J. W. Whitaker.

In the past, he said, fuel technologists have been drawn either from chemists or engineers. Now engineers, on the whole, are largely physicists dealing in feet and pounds instead of centimetres and milligrammes. Possibly the chief difference between physicists and engineers is that the former are more interested in theory and experiment, while the latter prefer the field of practical construction and utilization.

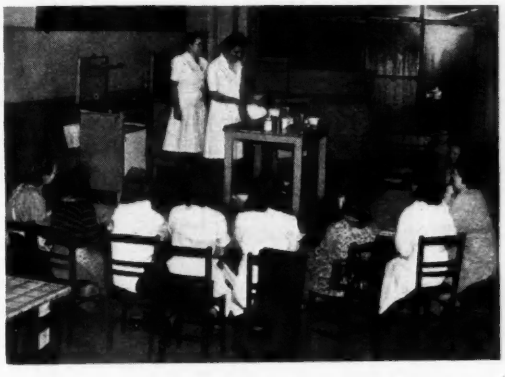
After dealing with general education and degrees and diplomas in fuel technology, the Author, discussing practical training, pointed out that the natural result of choosing for a career a subject whose boundaries are anything but well defined, is that the form of practical training for a candidate for the qualification of fuel technologist is equally nebulous. It will extend from those sections of fuel technology which are concerned with the discovery and mining or extraction of fuel from the earth to those concerned with the utilization of fuel, and even with the utilization of certain end-products, such as steam and electricity. It is not easy, therefore, to state one perfect scheme of practical training for a fuel technologist. One cannot say that any form of practical experience in each of the fields concerned is sufficient. Emphasis, at one stage or another, must be laid on the study of the fuel substance and its combustion. Nevertheless an extensive knowledge of, say, the geology of fuels will lead eventually to a fairly good acquaintance with their chemistry and physics, and (in this commercial world) sooner or later to a knowledge of the economic factors concerned.

Moreover, a study of mechanical or electrical energy will usually drive the engineer back to problems concerned with the fundamental nature of fuel and combustion, and eventually to a study of thermodynamics, heat engines, boilers, and so forth. In the realm of metallurgy a large number of processes involve the use of fuel, and not infrequently of fuel in some special or particular form. Indeed for years fuels and metallurgy have been associated subjects, and it is highly probable that experience in most fields of ferrous metallurgy will be suitable experience for the fuel technologist, more especially if, as is usual, the work extends into the regions of refractory materials, furnace linings, furnace design, and so forth.

## Factory Girls Learn Housecraft

The Liverpool Gas Company's demonstrators began a series of cookery and housewifery lectures to factory girls on Jan. 7 at Messrs. J. H. Robinson & Co.'s Canteen, Mill Lane, Old Swan. The girls followed with practical work. This is an entirely new innovation, in line with the Company's policy of selling a service rather than a commodity.

The course is for one evening a week for 12 weeks, and is operated in triplicate on Mondays, Tuesdays and Wednesdays. The fee for the course is 10s., of which 5s. will be refunded at the end of the course to all those who complete a minimum of 75% attendances. The Gas Company supplies all ingredients, including rationed goods, and 5s. of the fee is to re-imburse the Company for this expense.



*Liverpool factory girls learning how to make use of gas appliances in their homes.*

The view taken is that it is of small use to fit high-grade appliances in a consumer's home if there are no facilities for the housewife to obtain first-hand information on how to use them, hence the scheme now started at Robinson's, which will be extended as demonstrating staff permits.

During the war the Company, co-operating with the Ministry of Food, gave 1,645 demonstrations to 70,000 housewives, besides operating the first mobile demonstration unit in the country. This was a furniture van, later replaced by a handsome vehicle specially constructed for the purpose.

## Welcome Home

*A warm welcome being extended by Mr. R. J. Gregg, Sales Manager, to the first arrivals from H.M. Forces of the numerous employees of Ascot Gas Water Heaters, Ltd. Among these familiar faces are Messrs. Behr (London Manager), Blowers (Technical Department), Montgomery (Research and Development Department), Smyrk (Service Department), Jackson (Educational Department), Hillier (Statistical Department), Johnson (Sales Department), Oliver (Technical Department), Taylor (Training Centre), Penfold (Service Department), and Hatrick (Sales Department). Nearly all are well known in the Gas Industry, and they are all looking forward with considerable eagerness to renewing their acquaintance.*

**Three Scottish Gas Salesmen's Circles** are to hear a Paper on "Space Heating by Gas" by Mr. H. E. Robinson, of the associated firms of Radiant Heating, Ltd., and Arthur Docking & Co. The Western District will meet on Jan. 30 at 6 p.m. at the Glasgow Gas Department Showrooms, the North-Eastern District on Jan. 31 at 6.30 p.m. at the Dundee Gas Department Showrooms, and the Eastern District on Feb. 6 at 3 p.m. at the Chamber of Commerce, Edinburgh.

# Radiant Heat Burner for use on Solid Top Ranges

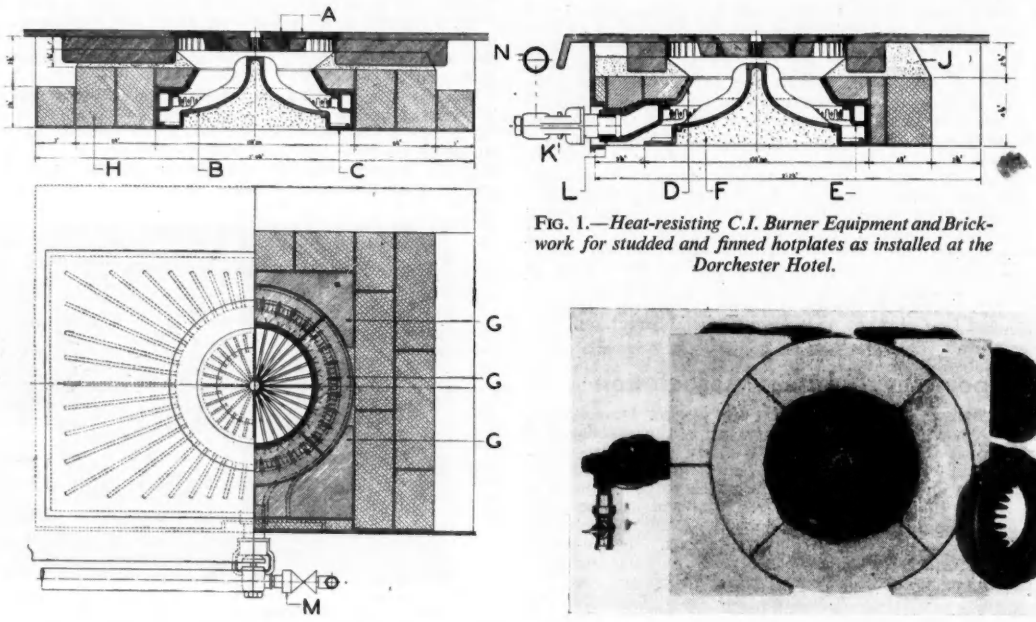



FIG. 1.—*Heat-resisting C.I. Burner Equipment and Brickwork for studded and finned hotplates as installed at the Dorchester Hotel.*



FIG. 2.—*Assembly of burner and refractory housing.*

Heavy duty cooking equipment includes the solid top range. This type of unit is in common use where a very high surface temperature is required, gradually falling off to a comparatively low temperature at the outer edges, which can be used for simmering.

Owing to the rough usage invariably met with in large kitchens, hotplates and burner equipment must be strong, and capable of standing up to blows from heavy saucepans and other cooking utensils. One design of burner employs a central cone and directs a cone of flame through the bullseye. This burner, which was originally designed and developed by the Gas Light & Coke Company at Watson House, has the twofold effect of producing the required high temperature in the centre of the hotplate, together with the central flame favoured by many chefs.

A refractory cone, although unaffected by gases at high temperature, is unsuitable because it is mechanically not strong enough to stand up to the heavy duty demanded. Frequent breakages of the refractory in the kitchens of the Dorchester Hotel, Park Lane, London, led the Gas Light & Coke Company, in collaboration with the Dorchester Hotel, to design a cast metal burner.

Ordinary cast iron is unsuitable for this work because the constant heating to 800°–1,000°C. and cooling off causes oxidation and growth, resulting in deformation and breakdown. Heat-resisting cast irons were therefore used, and fig. 1 shows a drawing of the equipment. "A" is a finned bullseye and ring mounted flush with the flat top of the hotplate. Both these are removable if required. The finned centre cone "B" and supporting ring "C" are heated by flames from the burner ring "E." The cone is filled with refractory concrete "F," and, when hot, has a substantial heat reserve. This cone has the great advantage that fat, paper, and other materials burn rapidly on the hot surface and do not clog the burners. The whole of the hotplate is finned underneath to increase thermal efficiency, and to make the utmost use of the available heat at the outside edges.

The combustion chamber is bounded on the other side of the cone by a ring "D," which serves to support the refractory "G."

A feature of this refractory is that it is in the form of moulded blocks which permit of easy assembly and give a neat finish. It also allows the ring and centre cone to be easily withdrawn if necessary, thus simplifying maintenance—of great importance in a busy kitchen. The moulded blocks are backed by refractory insulating bricks "H."

The fins of the outer solid top plate are fixed on to the brickwork with cement "J." These fins at the back are completely blocked by the cement, forcing the products to travel through the side and front fins into side channels, which in turn feed into the main flue outlet at the back.

The burners are aerated, and the gas is fed through the float "N" and the injector "K," of size 11 Morse. A control cock is fitted at "M." The burner equipment is designed to be easily removable, the injector sleeve being a sliding fit in the mixing tube "L."

The unit is economical, the full-on burner rating being 95 cu.ft./hr. at 21/10 in. W.G. The gas is appreciably less than that required to do the same job before conversion, much more of the available heat now being utilized. As the redesigned hotplate was required to fit in the same space as the original equipment, use had to be made of existing supplies and fittings.

Fig. 2 shows the assembly of burner and refractory housing, comprising the centre cone, the bullseye, and the inner finned hotplate ring. Twelve hotplates have now been in use for over six months and have given every satisfaction to the user.

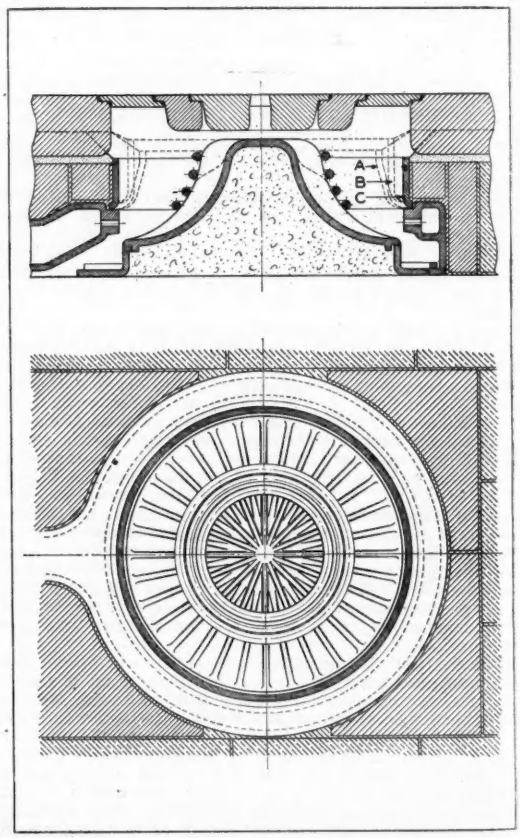



FIG. 3.

Experience over this period has shown that the bullseye is actually fiercer than required. In consequence minor modifications of design have been made to spread the available heat more evenly over the centre rings. This has taken the form of a bigger central cone, a drawing of which is shown in fig. 3. This cone is shaped to deflect more radiation on to the top plate; the effect of rods round the cone, as shown, in improving the radiating efficiency is to be tried.

Three other types of supporting rings, A, B, and C, are in course of development. The ring in the position C has the advantage that the central cone can be removed by lifting out without disturbing the ring. The gap between the central cone and the ring, through which the products of combustion flow, is, however, greatest in this case, and work on all three types of ring will determine a setting which will be the most satisfactory compromise between easy maintenance and efficiency.

Any manufacturer interested in the use of this burner for post-war equipment can obtain full details from the Gas Light & Coke Company.

## Reports on German Industry

The Board of Trade, as reported in the "JOURNAL" of Dec. 19, announced last month the publication by H.M. Stationery Office of a first batch of 28 scientific and technical reports on German industry, prepared by teams of experts under the auspices of the Combined Intelligence Objectives Sub-Committee (C.I.O.S.) and the British Intelligence Objectives Sub-Committee (B.I.O.S.). A further batch of 19 reports was announced in the *Board of Trade Journal* on Dec. 22, 12 on Jan. 5, 1946, and 29 on Jan. 12.

The reports so far published deal with a wide range of subjects, including chemical industry and chemicals, synthetic fuels, plastics, synthetic rubber, cellulose, drugs and biological products, gas turbines, radar and electronics, steel works, &c.

Copies of these reports, as they are published, are being supplied to universities, professional and technical institutions, trade associations and the principal public libraries. A list of the public libraries at which they may be consulted is given in the *Board of Trade Journal*. A limited number of copies is obtainable from the Stationery Office at prices of 6d. and upwards per copy.

## Labour for Light Castings

The Ministry of Labour and National Service states that an acute shortage of workers in iron foundries is seriously delaying the production of light castings for the housing programme (such as baths, gas and electric cookers, grates, soil pipes and guttering), and also of engineering castings needed for industrial reconversion. In view of this, young men who become redundant in non-ferrous metal and steel foundries or who can be released from such work will be directed to work in iron foundries, subject to the usual right of appeal. The work to which they will be directed will justify deferment of call-up for military service.

This step is the result of a recommendation of a Committee on Special Methods of Recruitment to Iron Foundries, recently set up by the Minister of Labour and National Service to consider how best to meet the urgent demand for skilled and unskilled labour in the ironfounding industry. The ironfounding section of the iron and steel industry is a basic one for which a very large number of men must be recruited. The number needed cannot be exactly estimated, but is certainly of the order of 35,000, of whom 15,000 are needed for builders' castings.

## New Plans for Smoke Prevention

New methods for the further reduction of smoke in towns and its prevention in new building areas are detailed in a booklet which the National Smoke Abatement Society has prepared specially for local government authorities. It is pointed out that legislation in respect to smoke has so far been punitive, and concerned only with mitigating a nuisance already committed. Public and a good deal of official opinion has now reached the stage where legislation should be preventive, and concerned with conditions which result in smoke.

What is required, the booklet states, is "simply that plans and specifications of all proposed new fuel-burning plant should be approved by a competent authority before installation. This does not imply prescription as to what particular plant, fuel or method must be used. It is concerned only with the standards and suitability of the installation proposed, having regard to smokelessness and related factors such as general efficiency and adequate capacity for requirements."

It is suggested that plans for all new or reconstructed heat-producing plants should be filed with the local authority. If adequate action can be taken promptly, practically the whole of the post-war building and re-equipment programme can be made smokeless. One of the first steps that a local authority should take in smoke prevention activity is to set an example to all by ensuring that all its own premises, and premises under its direct control, are rendered smokeless.

The larger local authorities are also advised to take powers to establish smokeless zones similar to those now being sought by the City Corporations of London and Manchester.

## Scarcity of Cooking Equipment

The Government scheme for the installation of families or boarders in existing empty rooms in private homes until adequate housing can be erected has met everywhere, in Scotland, with the problem of inadequate cooking facilities. While in theory the scheme is sound, it has been shown in practice that the position just does not allow the allocation of cooking equipment, since the required equipment does not exist.

Typical of this experience is the Glasgow position. The Housing Committee has reported that preliminary meetings were arranged with the Gas and Electricity Committees, and with officials of these departments, to ascertain what support could be given them in the policy of installing new residents. These Departments had to report that they held no stocks of full-sized cookers or smaller cooking appliances, and saw no prospects of any additional supplies maturing in the near future. This reply has forced the Glasgow Corporation to report to the Department of Health that it sees no prospect of the procedure functioning while the existing lack of cooking facilities limits the position. In agreeing to proceed with an appeal for rooms, the Corporation will make it clear that they have no cooking facilities available for distribution at the moment, and that any agreement come to, to allow the use of rooms, excludes the granting of cooking facilities.

## Whessoe, Ltd., Programme for 1946

The latter half of 1945 saw a major change in the type of work in hand at the Darlington works of Whessoe, Ltd. Till then a large percentage of the output had been for direct war use, and while the Gas Industry absorbed much of the then remaining capacity, the change that has occurred is exemplified by a selection from the order-book of work in hand at the beginning of 1946.

Plant for a by-product coke oven gas stream for London is now in course of manufacture. This is for the Gas Light and Coke Company's Beckton station to the order of the Woodall-Duckham Company. It comprises four Whessoe vertical tube multi-pass condensers for primary and secondary cooling, primary and secondary W.W-D. electro-detarrers, duplicate ammonia and naphthalene scrubbers, a liquor cooler, and a range of tar and liquor tanks.

Direct contracts are also in hand for the Gas Light and Coke Company for W.W-D. electro-detarrers for C.W.G. treatment at other works of the Company, while second or third installations of W.W-D. electro-detarrers are in progress for Wandsworth, Exeter, Watford and St. Albans, Leicester, North Middlesex and Tottenham. First W.W-D. detarrer installations are in hand for Uxbridge (High Wycombe), Exmouth, East Hull, Shrewsbury, and the Rochester, Chatham and Gillingham Gas Company. Wandsworth, Rochester and Preston are installing the new Whessoe vertical tube multi-pass condenser. Horizontal tube type condensers are to be built for the Croydon Gas Company and coke oven type coolers for the Consett Iron and Steel Company—this last to the order of the Woodall-Duckham Company.

A recently completed Whessoe static scrubber (preceded by a W.W-D. electro-detarrer) at Newmarket is to be followed by a similar composite installation at Newton Abbot, where other Whessoe plant is to be installed in addition. A comprehensive purifier installation is being built for the Sunderland Gas Company. A 3-million cu.ft. Whessoe spiral holder for Darlington Corporation will be built with conventional riveted lifts in a tank 189 ft. 6 in. diameter, which is to be of the welded type. The largest pressure gasholder in this country, possibly in the world, is in the course of construction for the Birmingham Gas Department ; it is of the cylindrical type 200 ft. long, and is designed to meet peak demands by the release of over 450,000 cu.ft. Another pressure holder, this time of the spherical type, is in hand for Staplehurst to meet the needs of the Mid-Kent Gas Company's district.

Exports are being actively pursued, and overseas contracts include W.W-D. electro-detarrers for Australia and New Zealand and the modernization of existing W.W-D. plants in Europe. Condensers are to be shipped this year to Rio de Janeiro, while Whessoe staffs are engaged in building and welding four spherical pressure containers for volatile liquid storage and other important plant in the Dutch West Indies. Shipments are programmed for other parts of the Western Hemisphere, the Middle East and Far East, much of the work involving large-scale field welding activities under overseas conditions by Whessoe staffs. In these ways Whessoe is demonstrating the ability of British industry to re-enter the important export field.

**The Heat Treatment and Industrial Section** of the Coventry Gas Department is to be transferred from Kenilworth, where it has operated during the war years, to a site within the City adjacent to the administrative offices and the Distribution Department.

**The Institution of Chemical Engineers,** in association with the Institute of Petroleum, the Association of British Chemical Manufacturers, and the British Chemical Plant Manufacturers' Association, has addressed a memorandum to the Government on the supply of chemical engineers to meet post-war requirements. A meeting to discuss the matter with members of Lord Hankey's Technical Personnel Committee has been held at the Privy Council Office.

# Bread Baking*

By A. E. LIVETT, Gaslight and Coke Company.

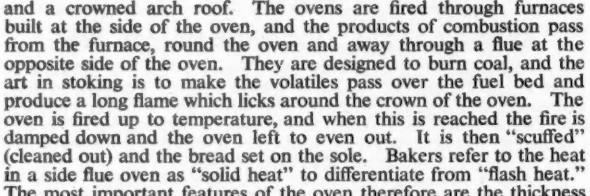
IT is of particular interest that whereas the industrial possibilities for gas vary very widely in gas undertakings' areas, in every one of them the residents eat bread, and generally speaking bread is baked locally; all gas suppliers are therefore equally interested in the future fuel used by their bakers, and if the job is tackled with vigour *now* the future fuel will be gas in the vast majority of bakeries. There is little doubt that the next five years or so will see enormous numbers of new ovens installed, and the fuel chosen for these will be continued for the useful life of the ovens, possibly 15 or 20 years. The problem is an urgent one.

The necessity for hot water in the bakery opens up another field for the gas supply undertaking. It is estimated that 0.2 therms per sack are required for bread baking alone.

*Intermittent Ovens.*—The side flue oven, in which the combustion of the fuel used takes place in the baking chamber, is an intermittent oven. These ovens, built either as single or double decks, are of brick construction with a flat sole (floor) of tiles, each one foot square, and a crowned arch roof. The ovens are fired through furnaces built at the side of the oven, and the products of combustion pass from the furnace, round the oven and away through a flue at the opposite side of the oven. They are designed to burn coal, and the art in stoking is to make the volatiles pass over the fuel bed and produce a long flame which licks around the crown of the oven. The oven is fired up to temperature, and when this is reached the fire is damped down and the oven left to even out. It is then "scuffed" (cleaned out) and the bread set on the sole. Bakers refer to the heat in a side flue oven as "solid heat" to differentiate from "flash heat." The most important features of the oven therefore are the thickness and quality of the brickwork, which must be so designed as to take up the maximum amount of heat and to give this up slowly and regularly during the baking process. The older type of baker is still very much in favour of the side flue oven, and it is extremely difficult to persuade him that a patent oven will give the same results. Many London bakers have had fitted to their side-flue ovens a conversion set for gas firing. The results obtained vary, and are dependent on a number of factors. In some instances we may obtain comparatively good results of 3 to 3.5 therms per sack, whereas in other cases it may be 5 therms a sack.

## Continuous Ovens

Now let us consider continuous ovens; it is convenient to do so in the following manner:




*"Peel" Oven.*—A "Peel" oven is an ordinary oven where the bread is set into the oven, and after baking withdrawn with a spade-shaped wooden implement known as a peel. This oven may be of brick construction or of sheet metal and may be fired either by steam pipes or hot air. It is possible to obtain from a good "peel" oven at least one batch of bread per hour. Suppose that an 8 ft. by 6 ft. double-deck oven in is use; this will have 96 sq. ft. of surface and will take 96 quarterns of "bloomer" bread, that is, one sack of ordinary bread. It is possible to load this oven with something more than a sack when tins are used. Similarly, a 6 ft. by 4 ft. double-deck is approximately a half-sack oven, having 48 sq. ft. of baking surface.

In general practice with gas-fired patent ovens, consumptions in the region of three therms per sack or less are normal. Quite recently I conducted a test on a steam-pipe oven, where it was found that the consumption per sack was 2.9 therms; the other appliances in the bakehouse, which were a water heater, a steam boiler and a ring, were consuming 0.5 therms per sack of bread baked.

*Hot Air Ovens.*—Under this heading there are ovens consisting of baking chambers surrounded by flues. These ovens are heated by the products of combustion or flue gases passing round the oven chamber. They are generally double-decker ovens in order to obtain the greatest efficiency and the greater heat exchange. When on solid fuel the furnaces are fairly large and consume considerable quantities of fuel. Trouble sometimes results from the necessity for cleaning flues and dampers. When constructed for gas firing they are economic in operation, and lend themselves very easily to thermostatic control. They are normally fired from the front of the oven by means of a number of industrial jets on manifolds with suitable by-pass equipment.

With gas-fired ovens there is no necessity for firing up on Sunday morning, and with most types, either hot air or steam pipe, baking temperature is obtainable in about two hours from lighting up the oven, that is, from cold with a rise of 100°F. per hour. It is possible to incorporate clock control in conjunction with thermostatic control, so that it is not necessary for anyone to attend to the oven, and it is automatically available when the bakers have their dough ready. The efficiency of heating by gas is of a very high order. The even distribution of heat with gas firing is another important factor.

*Steam Tube Ovens.*—Now the steam pipe or steam tube ovens operate on a very different principle. The steel tubes containing a small quantity of water are fitted in the oven, one end of them projecting into a furnace; these are heated by the fuel in the furnace, and the water in the tubes is evaporated; the resultant steam heats the tube which is in the baking chamber, and the tube, while under pressure, continues to act as the heating element. Sufficient tubes are fitted to give the necessary even distribution of heat, and this method is now universally used by oven builders for ovens, either "Peel" or drawplate.

In some double-deck ovens there are four sets of tubes, while in others there are merely three. With the four sets of tubes each oven can be fired separately, whereas with the three sets of tubes the centre tube gives a top heat to the bottom and bottom heat to the top oven. It is possible to design a steam-tube oven to fire from either end or side. In the majority of cases where solid fuel is used the stoke-hole is at the back of the oven.

One of the disadvantages of steam-tube ovens operating on solid fuel is the liability of a burst tube due to overheating. There have been a number of these accidents at various times, and quite recently, when one of these accidents occurred, it was the means of finally persuading the baker to have the oven converted to gas firing. You will readily understand that with gas as the fuel it is possible to give the correct amount of heat to each tube in the oven so that no one tube is likely to get overheated.

*Drawplate Ovens.*—These are built in a manner somewhat similar to the "Peel" ovens, except that the whole of the sole of the oven is steel plate mounted on a chassis. The oven is fired up to temperature, and when ready for setting the plate is pulled out into the bakery, and tin bread, or whatever batch is to be baked, is placed on the plate and the whole pushed back into the oven. By virtue of the type of oven and the question of heat loss, it is essential that the operation of loading and unloading the oven should be carried out as quickly as possible. This requires the presence of adequate labour, for if the plate is left out too long the temperature drops and the oven is cooled as a result of the cold plate being pushed back in again. With suitable labour available very good results are obtained, and their output is greater than that of the "Peel" oven.

## Mechanical Travelling Ovens

There are several types of travelling ovens, among them being the swinging tray and the travelling sole. The oven is split up into compartments, and it is possible to control the temperature at various stages along the oven to that required. It is quite possible that one part of the oven would be at 400°F., the next at, say, 500°F., and the next at 400°F. The bread passes through 400°, 500° down to 400°, and so is discharged at the end of the oven; the temperature and speed can be controlled to suit the type of bread being baked. Upon examination of an oven of the travelling sole type, which was giving absolute satisfaction to the executives of the firm concerned, fine results being obtained, it was found that the gas used was in the region of 2.2 therms per sack. Referring to the question of brick-built or sheet-steel construction, I think that the future will tend to see more of the sheet-steel oven built. There is no doubt that within the next five years the proposed housing programme will absorb many of the building labourers, especially the bricklayers. This will result in a shortage in the industrial field, which may mean that the sheet metal construction will enable better delivery dates to be given than would be possible for the brick built type. Furthermore, the release of sheet steel as the result of the closing down of the war industries will make a greater percentage available for construction purposes for work of this type.

It is my impression that the efficiency of the steel construction is equal to that of the brick built type, and therefore there may be a complete swingover until such times as there is labour available to build the brick ovens. It may be that as the result of availability of sheet steel the baking trade may never go back to the brick-built ovens, but this we shall see. It is not a point that vitally concerns us as a Gas Industry. We should see that the fuel supplied by us should be used in an oven with the greatest degree of efficiency, and whether it is brick built or portable steel does not really matter. Whatever the outcome, we have to consider that the baking trade has been short of craftsmen during the war. It is now trying to attract new blood and to improve the conditions generally in the bakehouse, and to do this, and bearing in mind that the oven is the heart, as it may be termed, of the baking business, a good oven is essential. If

* From a Paper presented to the London and Southern District Junior Gas Association, Dec. 14, 1945.

it is gas-fired there is less labour required to carry out the work and production will proceed more smoothly. Furthermore, the better type of craftsman is not prepared and will not be prepared to be a stoker or ash remover as well as the special craftsman in producing the food for the customer. In looking into this question of oven production and the types of ovens available, it does seem to me that the oven builders to-day are more gas-minded than they ever have been, and are more prepared to work with us than they ever were and do realize that we are out to give a very good service—one which we consider will be unequalled from any of our competitive fuel suppliers.

## Competitive Fuels

As in other types of industrial premises requiring heat services, the following are in competition: coal, coke, oil, gas, and electricity. Coal and coke represent the cheapest form of fuel available on prime cost, the advantage of cheapness, however, being largely offset by the necessity for storage and the difficulties of handling. In some bakeries before the war mechanical stokers were tried out, but never seemed to be likely to have a great following, and subsequently many of these plants were scrapped. In the majority of bakeries using solid fuel hand firing is normally employed, with the resultant extra labour necessary for stoking and generally looking after combustion.

As probably most of you know, the greater majority of the London bakeries were of the underground type, and had one or more side-flue ovens, which were solid-fuel fired, using coal. The use of solid fuel in this type of bakehouse makes it extremely difficult to keep the bakery in a condition suitable for the production of food. Whereas coal is mostly used on the side-flue ovens, the use for coke is on steam-pipe ovens and in some cases hot-air ovens where the furnaces are generally to be found at the rear of the oven or at the side.

Under normal conditions provisions are made to store the solid fuel away from the bakery proper. Even so, the attendant disadvantages of using solid fuel, which includes the necessity for storage of the fuel, together with ash removal, and the necessity for a man to be in attendance some time before the oven is required in order to light up and stoke it ready for use, are very real, and most bakers seem to desire to overcome these difficulties as soon as they possibly can. A measure for their desire for a change can be seen in the fact that prior to the war many installations were being fired on fuel oil, where, although the necessity for storage remains, it is simplified by the fact that with this type of fuel there is a greater degree of thermal concentration and there is no handling of the fuel or removal of any residue, and the control of combustion, when compared with solid fuel, is better.

There are various types of burner equipment available for this purpose. The method of application is relatively simple and easily controlled, and there are a number of side-flue ovens and steam-pipe ovens fired in this manner. However, there are disadvantages in using oil fuel in the bakery. The smell is almost impossible to eliminate, and is, of course, accentuated by any leaks that may occur. The intensity of the flame in many cases necessitates expenditure on furnace repairs.

We now come to the question of town gas as applied to the baking process. The elimination of fuel storage renders possible the installation of a second oven in the space previously occupied. The reliability of the supply and the perfect control of combustion, and the simplicity with which it may be handled, are such that the bakers' ovens require no extra handling, as does the stoking, say, of a solid-fuel fire. The oven in effect becomes almost automatic, and controlled temperatures are always attainable. Coupled with this is the fact that there is a tremendous saving in repairs and wear and tear of the ovens and furnaces. We know of many instances of ovens installed as long ago as 1937, on which up to the present moment there has been no need to expend money for repairs or replacements.

All that has been said in favour of gas can be said to a degree of electricity, with one exception, which I think is true—that a greater ease of control at any temperature is obtainable on gas-fired equipment than is possible with electric ovens.

Up to this moment we have not dealt with the question of cost, which can best be treated as a separate item. I have tried to show that even without the question of cost, the full consideration of fuels available and the summing up of their relative advantages and disadvantages makes one feel that in the matter of fuel conservation alone gas is the correct fuel for the baker.

Regarding prime costs of fuel: In Appendix I is shown the relative cost of fuel over the periods from 1937 to 1938, and from 1943 up to the present day. Most of you are aware that solid fuel has gone up in price to the consumer at least 100% on pre-war prices, and fuel oil to-day is almost three times what it was in 1937. At the end of the Appendix the cost in pence per therm prime cost is given.

The important point I wish to make from those figures is that on prime costs gas at 8d. per therm is just over twice as expensive to purchase as the solid fuels, and also of course oil is just about 1½d. per therm cheaper than gas at 8d. In actual fact, in the majority of cases which have come to my notice, where gas is available at 8d. per therm, it is only 50% dearer in running cost than solid fuel at present-day prices. The vast improvement in favour of gas is brought about by the fact that the efficiency of application on solid fuel, especially in the side-flue ovens, is of a very low order, and as one would expect, the application of gas with its normally higher efficiencies of combustion does make a tremendous difference in the actual cost per therm of the heat utilized. I would like to point out here that in one particular instance where at one premises the consumer has a double deck gas-fired patent oven, and at his other business premises a double deck side-flue oven on coal, the actual cost of fuel used is cheaper on the gas oven at 8d. per therm than on the side flue oven on coal.

When considering the question of the cost per therm for town gas as against the cost per therm for fuel oil, the relative prime cost being 8d. and 6.4d., oil commences with an advantage of 1.6d. per therm. It is my impression that in actual running cost there is a small margin either way, and that at this price, and, bearing in mind the cost of installation and the attendant disadvantages of this fuel and equipment compared with gas, it is not really sufficiently attractive at present-day prices to be considered as a keen competitor. In the event of a reduction in price of oil, then consideration would have to be given to the question of this fuel as a competitor, but with conditions as they are to-day, and, by driving home to the baking trade that gas is the right fuel for their job, gas undertakings should be in a strong position to meet any sort of competition.

The question of electric competition has to be faced, but it would mean that electricity would have to be available for the baking trade at an extremely low figure. With the abolition of night baking, the whole baking industry may be put into a position where their demand for heat service will be from 5 a.m. onwards, which is not so attractive to electricity undertakings as it then ceases to be an off-peak load.

The theoretical heat requirement to bake a sack of bread is approximately 80,000 B.Th.U. This is based on the heat utilized in evaporating water from the dough during the baking period, and heat required to raise the dough to baking temperature, &c. We can therefore express the *net* efficiency of bread baking as follows:

| Type of oven. | Therms consumed per sack. | B.Th.U. input. | Theoretical. | Net baking efficiency. |
|---|---|---|---|---|
| Side-Flue Oven (conversion) | 5 | 500,000 | 80,000 | 16% |
| Ditto | 4 | 400,000 | 80,000 | 20% |
| „ | 3.5 | 350,000 | 80,000 | 22.8% |
| "Peel" Oven | 3.0 | 300,000 | 80,000 | 26.7% |
| „ „ | 2.5 | 250,000 | 80,000 | 32% |
| Travelling Oven | 2.2 | 220,000 | 80,000 | 36.3% |
| „ „ | 2.0 | 200,000 | 80,000 | 40% |

## The Prospective Load

It would appear that the average amount of bread eaten per head of population is about 4 lb. per person per week. This is equivalent to some 208 lb. per annum, and the gas required to bake this amount of bread in efficient ovens is approximately 1.25 therms. Nationally this would mean, for some 47 million persons, 58,750,000 therms per annum, and this indicates a potential load for the Gas Light and Coke Company of 6¼ million therms per annum. This could be even greater if all ancillary appliances were also using gas, including steam boilers, water heaters, doughnut fryers, baking plates, proving rings, pendant heaters, and box lights. You will no doubt agree that it is a load worth working for, and it happens to have a most attractive load factor.

Every effort should be made *now* to enable the oven-builders to proceed with the marketing of ovens and other equipment, in the full knowledge that the Gas Industry is prepared to offer economic rates for gas to obtain this business. To-day, with every baker ordering new equipment or having existing plant rebuilt, is the time for the extension of our business, but, every chance that is missed and results in a solid-fuel oven being installed, is lost to the Industry for at least ten years.

### Appendix I.

*Relative Cost of Fuel.*

| | | B.Th.U. | Cost/therm, pence. |
|---|---|---|---|
| *Coke:* | | | |
| 1937/8 | = 36s. | 13,000/lb. | 1.62 |
| 1943 | = 63s. 6d. | „ | 2.6 |
| 1944 | = 73s. | „ | 3.24 |
| *Coal:* | | | |
| 1937/8 | £2 per ton | 14,500/lb. | 1.50 |
| 1943 | £3 5s. per ton | „ | 2.40 |
| 1944/5 | £4 4s. „ | „ | 3.25 |
| *Oil:* | | | |
| 1937/8 | £4 5s. per ton | 18,750/lb. | 2.44 |
| 1943 | £11 4s. „ | „ | 6.4 |
| 1944 | £11 4s. „ | „ | 6.4 |
| *Gas:* | | | |
| 1937/8 | = 4.75d. | 500/cu.ft. | 4.75 |
| 1943 | = 7.65d. | „ | 7.65 |
| 1944 | = 7.95d. | „ | 7.95 |
| 1945 | = 8.0d. | „ | 8.0 |
| *Electricity:* | | 3,412 B.T.U./Unit | ¼ 7.3 |
| | | | ½ 14.6 |
| | | | ¾ 21.9 |

*Cost/Therms.*

| | |
|---|---|
| Coke | 3.24 |
| Coal | 3.25 |
| Oil | 6.4 |
| Gas | 8.0 |
| Electricity | 14.6 at ½d. a unit. |

APPENDIX II.

*Bread Baking.*

CASE 1. *Coal*—2 Side-Flue Ovens.
Trade—23 sacks (approx.) = £95.
Fuel—£4 per week (25 cwt.).
Labour—£21 10s. per week = 22.5% on production.
Fuel percentage cost on production = 3.8%.

CASE 2. *Coke (Patent)*—1 Collins 10 ft. by 6 ft. D/D Coke-fired.
Quarter's consumption 16.5 tons at £3 6s. 8d. per ton = £55.
Trade—Bread only. 766 sacks per quarter = 59 sacks per week.
Cost approx. 1s. 5d. per sack.
Fuel cost per week £4 4s. 8d. = 1.8% on production.
Labour cost per week £29 = 12.2% on production.

CASE 3. *Oil Conversion*—5 Side-Flue Ovens converted to oil firing.
Quarter's consumption oil = 2,170 gallons at 10.75d. per gallon = £97 3s. 11½d.
Trade—Bread only, no confectionery. 820 sacks per quarter or 63 sacks per week.
This is equivalent to 2.65 gallons per sack.
Cost approx. 2s. 4½d. per sack.
Fuel cost per week £7 9s. 6d. = 3% on production.
Labour cost per week £34 = 13.6% on production.

CASE 4. *Gas Conversion*—2 Side-Flue Ovens converted to gas firing.
Quarter's consumption gas 2,078 therms at a cost of £71 16s. 8d.
Trade—Bread only (no confectionery). 520 sacks per quarter or 40 sacks per week.
This is equivalent to 4 therms per sack.
Cost approx. 2.8d. per sack.
Fuel cost per week = £5 10s. 6d. = 3.4% on production.
Labour cost per week—not available.

CASE 5. *Gas*—1 Baker Perkins 10 ft. by 6 ft. D/D S.P. Portable Oven.
Quarter's consumption gas = 1,416 therms at a cost of £47 19s. 1d.
Trade—Bread and mixed rolls, &c. (no confectionery). 515 sacks per quarter or 39.5 sacks per week.
This is equivalent to 2.73 therms per sack.
Cost approx. 1s. 10d. per sack baked.
Fuel cost per week—£3 13s. 9d. = 2.7% on production.
Labour cost per week—£21 10s. = 13.8% on production.

*Bread and Confectionery.*

CASE 6. *Gas (Patent)*—2 D/D 10 ft. by 6 ft. Baker Perkins S.P. Ovens, gas-fired.
Trade—Bread and confectionery. £19,000* for year 1944. Weekly = £370 approx. = 52 sacks bread. £175 confectionery.
Fuel—12,471 therms for 1944, £413.
= 240 therms (approx.) weekly average.
= approx. £8 per week = 2.1% on production.
Labour cost per week—£45 = 12.1% on production.

CASE 7. *Gas (Patent)*—1 D/D 8 ft. by 6 ft. Cox oven, gas-fired.
Trade—16 sacks bread, £150 small goods. Bread and Confectionery = £212.
Fuel—£3 6s. per week.
Labour—£39 per week = 18.4% on production.
Fuel percentage cost on production = 1.6% approximately.

*Confectionery.*

CASE 8. *Coal*—2 Side-Flue Ovens.
Quarter's consumption coal = 9 tons at £3 10s. per ton = £31 10s.
Trade—Confectionery only: 152 sacks retail £5,200 per week = £400.
This is equal to cost of £12s. per £100.
Weekly fuel cost—£2 8s. 5d. = 6% on production.
Weekly labour cost—not available.

CASE 9. *Gas (Patent)*—3 Baker Perkins D/D 10 ft. by 6 ft. ovens, gas-fired.
Trade—confectionery only: £700 per week.
Fuel cost—gas—£7 per week or 1% on production.
Labour cost per week £49 = 7% on production.

CASE 10. *Electric*—2 D/D Electric Ovens.
Trade £800 confectionery per four weeks = £200 per week.
Fuel cost—£11 14s. 9d. per four weeks at 16s. 8d. S.C. plus ¾d./B.O.T. unit = £1 9s. 4d. or 1.5% approximately.

* This figure includes 20% of production sold at wholesale prices, and consumer is of the opinion he could raise this figure to £24,000 retail in normal times without increasing his fuel bill.

## DISCUSSION

Mr. L. F. RANDALL (South Metropolitan) referred to the Author's heating-up figure of 100°F. rise per hour. He had found that too rapid a heat rise was not popular, and that a figure between 50 and 80°F. was more acceptable. Had Mr. Livett heard this preference stated? Automatic stokers had proved themselves a nuisance. The potential load for bread-baking totalled nearly 60 million therms and this was at the present time mostly in the hands of the solid fuel interests, and he felt that the Coal Utilization Council was not going to lie "doggo" on the question of automatic stokers. The results obtained from installations employing automatic stoking were very good, and the Gas Industry had to be ready to counter them. With oil now cheaper by 1½d. it now cost 5.9d. per therm, and nobody knew whether that price was not going to be even less. During the war the baking trade had made much money, and before long they were going to spend it on plant. The baking trade was now experiencing financial interests taking over large groups; one result of this grouping was that the Gas Industry would witness greater competition in the future, and they would have to be on their toes to get the load the baking trade offered. But he was not happy that the Industry had done everything towards efficiency of the gas-fired installation. It had been rather too conventional and too inclined, in the case of a conversion, to replace a fire with a gas burner. The key to success in obtaining this load lay in the cost of fuel.

Mr. R. F. HAYMAN (Gas Light and Coke) remarked that the Author made reference in his Paper to a swing-over to steel construction as opposed to brick, adding that it was not a point that vitally concerned them as a Gas Industry. But Mr. Hayman was definitely of the opinion that it did matter, and supported his view by stating that the heavier brick type gave a better quality loaf owing to the importance to the baking process of air temperature maintained by heat stored in the brick. In the steel-constructed oven he thought the temperature would be inadequate for the most important part of the process—*i.e.*, when the bread first entered the oven. He agreed that the Industry had to design ovens that were cheaper to run, but first it had to find some substitute for "solid heat," but it would be wise to ensure a constant inverse ratio between work in that direction and the number of bricklayers available.

Mr. N. JUNKISON (Gas Light and Coke) praised Mr. Livett's Paper as a mine of information. Regarding costs, he noticed that the Author had stressed saving in labour, but among the cases cited at the end of his Paper the labour cost percentage in a coke-fired installation was 12.2%, but this figure rose to 13.8% with a gas-fired oven of similar capacity. The gas-fired installation worked at an efficient rate equivalent to 2.73 therms per sack. The load factor was good, but he noted that production was less than in the coke-fired oven. Comparing oil and gas, the Author had stated that the costs did not vary much either way, but the cases he cited of oil conversion offered a coal saving of 12% per sack over gas. Mr. Livett had referred to a weekly bread consumption of 4 pounds per person. Mr. Junkison wished to know where this figure had been obtained, and did it refer to the war or post-war period.

Mr. W. JOHNSON (Wandsworth and District) thought that about 9% of the potential bread-baking load was now held by the Industry, but strikes and low pressure would damage their prospects. The public was not so forgiving to-day as in 1940. Outward appearance was an important aspect of bread-baking installations, and he agreed that the Industry must revolutionize design. Regarding the hourly temperature rise he preferred a figure of 80°F.

Mr. T. V. GARRUD (Gas Light and Coke) said there was no doubt that the baking industry offered the best load factor to-day.

Mr. SHELDRAKE (Gas Light and Coke) referred to "solid heat," already discussed by Mr. Hayman, and suggested that such heat existed largely in the imagination of the baker.

Mr. J. E. LAW (Tottenham and District) thought Messrs. Randall and Johnson were unduly pessimistic; to the speaker the indications were quite the reverse.

### The Author's Reply

In the course of his reply Mr. A. E. LIVETT said it had not been his aim in preparing the Paper to present the meeting with what he might call "salesmen's figures." Mr. Randall, he felt quite sure, would agree from progress made in the Gas Light and Coke Company's area during the past eight months—*i.e.*, four Peel ovens, five travelling ovens, and 24 side-flue installations constructed or in course of erection—that the load was well worth while. He found himself in agreement with Mr. Hayman's views regarding "solid heat," and suggested that the Industry attempt to achieve more in that direction. The bread consumption figures had been obtained from a census conducted among his office staff.

# Growth of the Job of Service Engineer*

By O. W. ROSKILL

THE more widespread use of improved domestic appliances of all kinds is likely to be one of the most characteristic trends of the next couple of decades. In days gone by the big house, whether in town or country, had no need for domestic appliances. Domestic staff was plentiful and wages were low—though it should not be supposed that working and living conditions were unpleasant, as many old ex-servants now testify. Poorer people were unable to afford much in the way of domestic appliances, and as the market was not there little attention was given to them by the manufacturers. The drastic reduction in the standard of living of the upper and middle classes has forced them to give the most careful consideration to the equipment of kitchens and sculleries which their grandmothers scarcely entered. There has been a fundamental change in the relationship of interest and wages. Fifty years ago £1,000 capital meant at least £50 a year interest after tax, which paid for two good servants. (The older generation of Forsytes despised Timothy for his 3% Consols and expected to make 10% on their capital.) To a moderate surtax payer the same capital sum to-day invested at comparable risk means perhaps £10 a year after tax. But £1,000 spent in the home may well save one or two servants, each costing, say, £75 a year wages and £50 a year board.

The bulk market for domestic appliances lies, of course, among the lower income groups, and in a few cases, such as electric irons, the level of usage is beginning to approach that in the U.S.A.—and indeed to approach saturation (80% of wired homes in 1939). In other cases, notably water heating, the market is still scarcely touched. According to the Heating of Dwellings Enquiry of the Wartime Social Survey, no fewer than 64% of all families with incomes below £300 p.a. had no piped hot water supply, but relied on pans and kettles heated on a fire, on a range with a boiler but without a piped supply, or on a coal, gas, or electrically heated copper or set pot. The corresponding figure for families with incomes up to £160 p.a. was 74%. On the basis of a sample survey into family income distribution carried out in Bristol in 1938, it has been estimated that the total number of families with incomes below £300 p.a. is over 9 million. It seems fairly certain, however, that the vast housing programme envisaged in the coming years will be accompanied by an enormous increase in the usage of domestic appliances of all sorts. While a good many different (and conflicting) estimates of housing requirements have been made, the most probable figure is, in my opinion, 5.3 million, divided between about 2 million to clear off 6 years' arrears of slum clearance, overcrowding, obsolescence and increase in the number of families, and 3.3 million for current needs, over the next 12 years. Without entering into the question as to whether these needs will be supplied, it is fairly certain that within the next couple of decades new building will take place to the extent of over half the existing number of houses in the country. The standard of equipment in these new houses, whatever their shortcomings, is likely to be much higher than has been the case in the past, and the conclusion that there is likely to be an enormous increase in the use of domestic appliances is reinforced by an examination of experience in the U.S.A., where once the ownership level of an appliance reaches a certain point it seems to go ahead very rapidly, partly perhaps because the appliance becomes regarded as a "conventional necessity," and partly because a big market obviously means mass production and reduced prices. Sales of mechanical refrigerators in the U.S.A. increased from 906,000 in 1931 to 3.5 million in 1941.

## Servicing Mass-Produced Appliances

Many of the new appliances which will be needed are, it has recently been announced, to be mass-produced to standard designs in Royal Ordnance Factories. It seems possible therefore that public utility undertakings may find themselves with substantial numbers of consumers in their areas who are using appliances neither chosen nor installed by the utility undertaking. The consumer will want service, and the Government has given no clue as to who will provide it. In general it pays an industry to see that its product is efficiently used, and this applies particularly to all the fuel industries. But the coal industry has, in effect, no organization for servicing domestic solid fuel appliances, and gas and electricity undertakings may well look somewhat askance if expected to service appliances from whose choice and installation they have been more or less completely divorced. Nationalization of the gas and electricity industries is unlikely to make any great difference to such an attitude.

In the past a high proportion of the gas and electric domestic appliances in use have been sold (or hired) through utility undertakings. The manufacturer has sold the greater part of his output to utility undertakings who have been responsible for installation and servicing, and have in many cases exercised a considerable influence on design as a result of their experience in these fields. The proportion of the total turnover sold direct to consumers through the retail trade or, say, through builders or builders' merchants, has not been great. Certain particular items form exceptions to this—for instance, electric irons and vacuum cleaners (the former sold largely through the retail trade, notably in specialist shops selling electrical and radio goods, and the latter through travelling salesmen and more recently through shops, especially department stores). Solid fuel appliances have, in general, been sold through builders and builders' merchants and rarely direct to the public, though many builders' merchants, particularly in provincial towns, have associated retail ironmongery and hardware shops. Some ironmongers offer a certain amount of service to solid fuel appliances, but in general, when these have needed attention they have, in the past, been repaired by builders—a position made logical by the fact that they were nearly always landlords' fixtures. A big change seems likely to take place in the next decade or so as there is a tendency, first, for solid fuel appliances to incorporate moving parts and to be of more complex design. This brings them, so far as servicing is concerned, out of the field of builders' work and much more into that of the fitter of engineering background, roughly parallel with the type of man required for service work on gas and electrical appliances. Secondly, there is a tendency towards the design of free-standing (I personally prefer this to the term self-setting) appliances.

The working class housewife of the future, when she moves home, may well take her slow-combustion cooker with her. At the present time there is no nation-wide organization for servicing solid fuel appliances in general. A few of the makers of the more expensive appliances maintain, generally through agents, organizations for servicing their particular appliances, and a few leading coal distributors employ combustion engineers able to advise on problems such as troublesome flues (which are one of the commonest troubles encountered with solid fuel appliances).

## Relation of Installation and Servicing

Returning now to a general discussion of the organization of service work, the first point to stress is the necessity for close relationship between installation and servicing. Unless installation work is correctly carried out, servicing will become a matter of re-installation. Nevertheless, I do not propose to digress on to the subject of installation work, beyond pointing out that close co-ordination between installation and servicing is very much easier where both are carried out by, or under the supervision of, the same organization, as in the case with gas and electricity undertakings, than when they are not. If a service organization is developed for solid fuel, it should also have general responsibility for installation work.

There is a tendency nowadays to conceive "general responsibility" as inevitably involving ownership and control under a single organization. This is not my conception. Many gas undertakings have, for instance, found that if they lay down the principles, methods and technique for carrying out installation, provide or organize the provision of training facilities and insist that only fitters trained to an approved standard should do the work, it is much better to let it be done, say, by builders. Most builders are small firms, and are much more likely to keep close contact with the customer than is a big public utility undertaking, however enlightened its public relations policy. Training on a big scale is, moreover, clearly involved for the installation and maintenance staffs of the public utility undertakings themselves, and there is no reason why training facilities should not be open to all comers who pay their share. It would be unfortunate if, in stressing the close relation between installation and servicing, I gave the impression that the training in the two cases is the same. In the case of solid fuel appliances, in particular, the fitter may have to know a fair amount about building and, even if not undertaking the work himself, be able to give sound advice on the best method of making alterations necessary in order, say, to replace a coal range by a slow combustion cooker. The service engineer increasingly tends to be more of a specialist in a certain type of appliance.

## Rough Estimate of Personnel Required

Consideration of service work leads inevitably to consideration of training for service engineers. Training may be divided under three heads: In the first place apprentice training; in the second, training of men who have already been engaged in other activities; in the third, refresher course to keep service engineers up to date with the latest developments in design and technique. The scale of the problem should not be underestimated. To give an idea of it (without commitment as to what the various figures—such as number of visits per year—ought to be) let us suppose the aim is to ensure in 10 years' time that every home in the country (say, 12½ million) received a visit twice a year from service engineers representing two out of the three principal forms of fuel and power (say gas and electricity or solid fuel and electricity); further, let us suppose that a service engineer working in an urban area can pay, on the average, about 2,000 visits per year of 50 weeks, then a total service force of 25,000 would be required. This

* Paper presented to the Institute of Fuel, London, Dec. 6, 1945.

excludes, of course, any allowance for installation personnel. The alteration due to the much lower number of visits per year in rural areas would not be of outstanding importance, as (in 1931) over 80% of the population of England and Wales, and 70% of that of Scotland, lived in areas classified as "urban" for local government purposes.* Two thousand visits per year is, however, a high figure, and the total installation and servicing personnel on domestic work in the fuel and power industries might well lie between 50,000 and 100,000.

## Annual Intake

Allowing for wastage, an annual intake of 5,000 apprentices a year while building up the organization, falling to half this figure for maintaining it after reaching the desired size, would not be an unreasonable guess. It is probable, however, that in the early stages a good many men would be recruited from the armed forces, permitting a more rapid build-up without placing an undue strain on the training facilities and staff, which are themselves a difficult problem.

Refresher courses are essential. At Watson House, before the war, the proportion of men being trained to men taking refresher courses was about 50/50, and the Gas Light and Coke Company, who did much pioneer work in the organization of service work and the necessary training facilities, had about 10,000 fitters and assistant fitters, each of whom was supposed to attend a refresher course once a year.

Hitherto such training facilities as there are have been developed by individual gas and electricity undertakings. There seems to be a case —quite apart from the future of the industries if nationalized—for organizing training on a national basis, probably with regional training centres. It is true that servicing methods, and of course the types of appliance in use, vary widely from the area of one undertaking to that of another, but nevertheless the advantages of some degree of pooling of training facilities might well outweigh this.

## Specialization in Servicing Work

This point is reinforced by the fact that it seems to be fairly general experience that it pays to specialize in organizing servicing work. Thus there are two possibilities: Either to send round one man trained to service all types of appliance, or to send round a man for cookers, another man for water heaters, another for space heaters and so on. The former generally results in quicker and more expert servicing, but may annoy the consumer, particularly if the water heater is out of order and a service engineer dealing with space heaters makes by chance a routine call. This situation can generally be provided for by giving all service engineers a general training as well as a specialized one, so that they can, in emergency, deal with problems other than those on which they specialize.

## Tools

Most well-organized service organizations devote great care to the design, selection, and provision of tool kits for fitters, and to ensuring that they are always taken to the job. Obviously specialization in servicing tends to mean specialization in tools, and in some cases, even, appliances are made so that they can, in effect, only be adjusted with the aid of specialist tools.

This leads to the question of the alternatives of regular servicing and servicing on call. The former is much the preferable, though only experience and accurate statistical control (which is as essential in a service organization as in any other) can indicate the correct number of visits per year for each type of appliance and fuel. There also appear to be variations in different areas. There are a very large number of consumers who will not ask for a service visit unless the appliance is right out of action, and it is in the interest both of consumer and of the fuel industries that appliances should be maintained at a high state of efficiency. Broken fire bars in a solid fuel water heater mean waste of fuel, which falls into the ashes; faulty connexions in electrical appliances may lead to danger of fire or even life; broken radiants in a gas fire mean that the customer is not getting all the useful therms he should for his money. A further argument is that there are a large number of appliances (often in public places) which numerous users are in a position to damage without there being any very clear responsibility for keeping them in good order.

## Cost of Servicing

If service is to be given regularly regardless of whether or not the consumer asks for it, the logical deduction is that its cost must be included either in the price of the fuel or in that of the appliance. In the case of public utility undertakings it is probably best included, as at present, in the price of the fuel, provided that the consumer buys or hires his appliances through the undertaking, as in the greater proportion of cases he does. The undertaking then has some control over the type of appliances used and their suitability from the servicing point of view.

It has already been pointed out that there are very few service organizations dealing with solid fuel appliances, but what there are are mainly run by appliance manufacturers or their agents, one example being a leading make of slow combustion insulated cooking range. In such cases it is vital from the customers' point of view—and in the long term from the manufacturers' also—that agents should not only be chosen with particular care, but obliged by contract to provide certain facilities and to conform to certain standards. Servicing to a sales agent does not normally offer the same financial returns as the distributors' margin on new sales, but if, as sometimes happens, existing customers are neglected in favour of new business (for which installation engineers may be required who might otherwise be on service work), the result will be disastrous. There is every reason for aiming at increased mechanization in the home for all classes—one of the most important means of increasing the standard of living. Reliability must, however, accompany mechanization—a washing machine out of order in less use than a copper. Reliability is unattainable without regular servicing. The work of servicing in its widest sense and the number of persons engaged in it may, in the next two or three decades, expand as rapidly as those employed in distribution did in the inter-war period. Indeed the expansion in the numbers employed in the distributive trades was to a large extent due to the steady increase in the public demand for service, meaning, in this sense of the word, for example, delivery from shop to home.

## Relation between Design and Servicing

That there should be a close relation between design and servicing has already been indicated. Industrial design tends sometimes nowadays to be discussed in terms of aesthetics, which is a fundamental error. If an article is being specially made by a craftsman for an individual or a limited group of individuals, then aesthetic considerations are likely to take a place of high importance because, implicitly, if a man has a thing made specially for him, cost is probably not the major consideration which affects him. But in dealing with the bulk market for mass produced domestic appliances, the good designer has to take into account a variety of factors: appearance, suitability for economic production, suitability of materials and manufacturing methods required to the makers' experience and equipment and, not least, suitability for servicing. Often these interests conflict, and one of the chief duties of the designer is to find the best solution. There is, for example, fairly frequent conflict between appearance and servicing. The latter demands, above all, ease of access, and while I would never suggest that good appearance is synonymous with a streamlined shell, nevertheless it is often not assisted by having all the nuts and bolts which may have to be removed dotted over the front of the appliance.

It is not always easy to ensure close contact between those concerned with servicing. It is easiest where the appliance manufacturer carries out the servicing of his appliances, but as already stated, this applies in a minority of cases only. Public utility undertakings are not generally directly concerned with design, though they often exercise a considerable influence on it through their purchasing policy, through their testing laboratories, and in some cases by getting designs which originated in their own research departments made by appliance manufacturers. Some of them find that close contact between the personnel of their research and testing departments on the one hand and their service departments on the other is very useful, and where this is possible it is probably the best course. A spell of "field work" as a service engineer is a very good experience for a young man in the research department who may be dealing with, or influence, questions of design.

At present the contact between design and servicing is far from good, and quite apart from any action on the part of the public utility undertakings it would probably pay those appliance manufacturers who do not normally service their own appliances to arrange for closer contact with servicing problems—for instance, rate of replacement of mica doors on certain types of solid fuel stoves, and the functioning of automatic ignition equipment on certain types of gas appliance.

## Education of Consumers

Not much has so far been said regarding the education of consumers. In recent decades men have been getting steadily more and more used to handling machinery. Such influences as the growth in car ownership, the mechanization of the army, and the expansion of the Air Force have greatly contributed to this. In May, 1945, 4,641,000 males, aged 14–64, were in the Armed Forces, of whom a very considerable number, probably at least half, had to handle machinery, including aircraft and aero-engines, tanks, armoured fighting vehicles and transport vehicles, marine engines and other sorts. A further 2,953,000 were employed in the so-called Group I industries, which include the bulk of engineering and chemical industries. The total male manpower was 14.8 million. Of women aged 14–59, 445,000 were in the Auxiliary Services and 1,539,000 in Group I industries.* Despite the present (and I hope temporary) place of man at the sink, domestic appliances in the main come within the purview of the housewife, and women are not good at handling machinery of any kind; nor do the very large numbers of women who have worked during the war in machine shops and the like appear to have produced any great change.

It is a curious fact that women can take the greatest pride in cleanliness, without which efficient functioning is impossible, without developing any real interest in the latter. The main reason probably lies in lack of interest in how a machine works—women in general are only

* The seven largest urban centres accounted for 42% of the total.

* *Ministry of Labour Gazette*, August, 1945, p. 126.

interested in the result. They press the switch and turn on the refrigerator, but they have little or no idea of what happens inside it; they have only the vaguest idea of how a gas water heater works, and very few indeed understand the simple principles of flues and draught control in solid fuel appliances.

Education, particularly during adolescence, can help enormously to change this position. The contributions which can be made by domestic science training to minimizing service problems and raising the standard of living is a very big one. All appliance manufacturers, as well as the fuel industries as such, should give full support to bodies which aim at propagating domestic science. Among these should perhaps be mentioned, for example, the National Council of Domestic Studies, which awards certificates to students in schools and colleges if taught by a fully qualified teacher of domestic studies. The gas and electricity industries have also been active in this field, the former through the Women's Gas Council, and the latter through the Electrical Association for Women. A wide variety of educational institutions, such as the L.C.C. Polytechnic (Regent Street) and the National Training College of Domestic Subjects, provide courses primarily (in most cases) in cooking, but also embracing laundry-work and general housecraft, &c.

Mechanization of the home seems likely to make rapid progress during the next couple of decades. All of the three principal fuel and power industries are likely to be involved (as well as oil and other fuels). So far only gas and electricity have built up good service organizations, and some undertakings are far in advance of others. Greater attention should be given to the problem by the coal industry, and in all three the vital job of training fitters might well be organized on a national and regional basis. The scale of intake of personnel required is likely to be large. Appliance manufacturers are also vitally concerned with servicing problems, whether or not they themselves carry out the work of servicing. A great deal could be done in the way of better consumer education, in which domestic science training colleges can play a big part.

## DISCUSSION

Mr. ROSKILL was unable to attend, due to illness, and the Paper was presented on his behalf by Mr. COE.

The PRESIDENT (Dr. E. W. Smith, C.B.E.) commented that the subject almost bordered on the commercial. But technicians could not derive satisfaction from their work unless that work was followed up, not merely by salesmen, but by engineers and technicians who would see that the intentions of the designer were attained to the best possible extent.

Mr. LEOPOLD FRIEDMAN did not think there was such a thing as free service. A man from a public utility undertaking who called to look at the appliances of a consumer was normally an all-rounder, and therefore, was not capable of performing the somewhat complicated process of diagnosis. It was very often a simple matter to put an appliance right, but it was more often than not a very complicated matter to find the fault. The work of the service men was not free, because somebody had to pay them. As the result of a long experience of service work, he pleaded for paid service and for specialized service. The situation might be painful if a specialist in water heaters, for example, was asked to tackle a cooker; but he urged that that policy was better, and in the long run cheaper, than to employ a man who did not know enough to be able to do any job. He was told that in one public utility undertaking in this country it cost quite a few shillings for a service man to knock at a door; if a consumer happened to be out, that meant money. Women could do service work as well as men; his own experience during the war, when quite a few women had been trained in service work, showed that in some ways the women were more conscientious, and, being more familiar than men with domestic matters, they did a cleaner and more satisfactory job, knowing that to leave dirt or soot about was not appreciated by a housewife. It was also thought before the war that women could not perform tests on domestic appliances; but the best testers in his organization were women.

Pointing out that there was a great difference between gas and electrical domestic appliances from the point of view of servicing, he said that gas appliances deteriorated gradually over a longish period, and there was no sharp line of demarcation between a satisfactory and a bad performance. Therefore, he suggested that a better term for the servicing of gas appliances would be "maintenance work." On the other hand, in the case of electrical appliances faults developed suddenly, and perhaps it was best to wait until something went wrong; and the term "service work" was a better description. For solid fuel burning appliances, someone should call at regular intervals rather than wait until something went wrong. With regard to training, he referred to a scheme in his organization whereby a questionnaire was circulated to members of the staff once per month, and they were required to answer in writing. They were permitted to use reference books and were encouraged to ask questions. Their replies were corrected and handed back to them, so that they knew whether or not their answers were correct. A monthly technical bulletin was also issued, bringing the technical information up-to-date. While agreeing that the larger the scale of the training, the cheaper was the cost of training per man, he urged that men could not be trained properly in large numbers; his organization had found that for an instructor to teach more than 12 people was not so satisfactory as to teach 12 or less. Finally, he said we were heading for a very mechanical age, and the users of appliances, both in industry and the home, were a long way behind the designer of the appliances; unless the gap was bridged, a lot of trouble might ensue. Mr. Roskill's paper was most opportune.

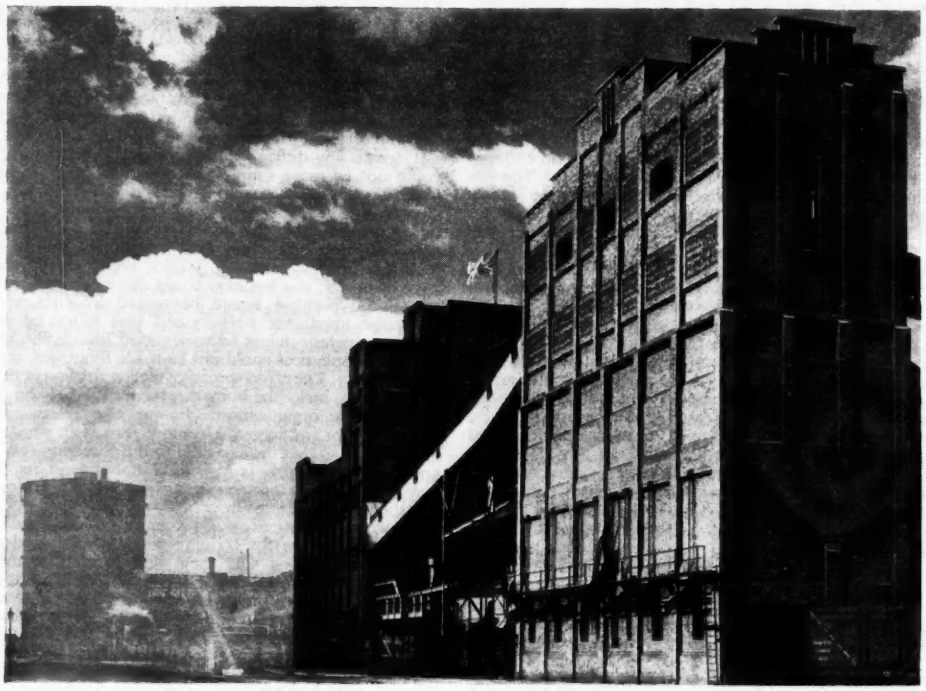
Col. PRICE WALTERS, who was concerned with the "bottled gas" industry, which supplied gas to people living in small hamlets, in caravans, houseboats, and so on, said that in a relatively small organization the service costs were of the order of £30,000 a year. That was not due to any difficulty in the operation of the appliances, for they could not be more simple. At the same time, in his experience the domestic appliance manufacturers did not give any service at all. Consequently, it was just as well that people should realize the extent of the responsibility that fell to the public utility undertakings or the fuel distributors in order that consumers should have the service required. In his business, service engineers of the all-round type were required; the business could not employ, nor did he think that any useful purpose would be served by employing, specialists in particular apparatus. He agreed that a service engineer was not really competent unless he understood installation work as well. As domestic appliances could not be made foolproof, the need for service still existed. The rapid spread of mechanization in the homes throughout the land, including homes in the most lonely hamlets, necessitated some service organization. It was also necessary to train fitters employed, for instance, by ironmongers, with whom his organization had to deal, so that they could give the necessary service, for obviously an organization such as his could not extend its tentacles to every hamlet, and ensure that every consumer was visited as often as he would like them to be visited.

He welcomed Mr. Roskill's reference to consumer training. There were organizations for training gentlewomen in domestic economy, particularly cooking, and they went to considerable pains to teach their pupils the utilization of every form of fuel. Also, the R.A.F. had a very good training scheme for W.A.A.Fs. who were leaving the Service. Such training was bound to reduce the costs of servicing, which ultimately must be paid for by the consumers.

The PRESIDENT said the Company with which he was associated until recently had for very many years maintained a staff to service gas-making plant. The country was divided into zones; the head of each zone had a number of men who visited regularly the plants which the Company had installed, whether or not they were asked to do so. The general policy was that any plant installed by the Company was the baby of the Company until it had completed its life. The service engineers would examine the results, examine the coal and take records in order to ascertain whether the plant was working reasonably up to its expected efficiency. If it were not, they would find out why, and would give the best advice possible as to different methods of operation or repairs and additions that would assist in achieving the necessary results. That was common practice among such firms. The Company with which he had been associated did not charge for that servicing, except through the original capital cost of the plant; of course, if there were special cases where special examination or lengthy tests were required, involving the attention of four or five men, a special arrangement would be made.

Mr. PILKINGTON (Messrs. Babcock & Wilcox, Ltd.) said the duties of a service engineer should begin in the late stages of erection, when for his own satisfaction he should assure himself that points affecting the successful operation of the plant had received due attention. That involved the closest co-operation with the erecting department. When erection was complete, the service engineer should take over the plant and supervise the preparations for setting it to work. During the first period of working he should supervise operation, and take every opportunity of initiating the operators into the proper use and care of any parts of the equipment with which they might be unfamiliar. At that stage he would also be on the watch for faults in material or performance, and would arrange to have them corrected. Once he was satisfied that the plant complied with the purchaser's specification, he should set about securing agreement to the official taking over. In normal circumstances he would have handed over routine operation to the purchaser's staff some time before that, but he should continue so long as he was on the job to put his experience at the disposal of the staff, aiming to leave behind him a sound plant in competent hands.

Mr. LIONEL LOCKETT, as a supplier of solid fuel for domestic purposes, said that the problem of servicing solid fuel appliances had in the past received a great deal of close study from certain solid fuel distributors; the enlightened among them would welcome Mr. Roskill's Paper, if only because it focused attention on the difficulties of that problem, and he hoped it would lead some distributors to realize that they must take stronger steps to overcome those difficulties. The servicing of solid fuel burning appliances involved grave difficulties, which did not arise so much in the case of gas and electricity. If a merchant, say, in Reading set up a servicing department and serviced solid fuel burning appliances, there was nothing to prevent the consumer buying his fuel from a different merchant. So that distributors had to consider whether they might be put to the expense of servicing only for the benefit of their competitors, except in so far

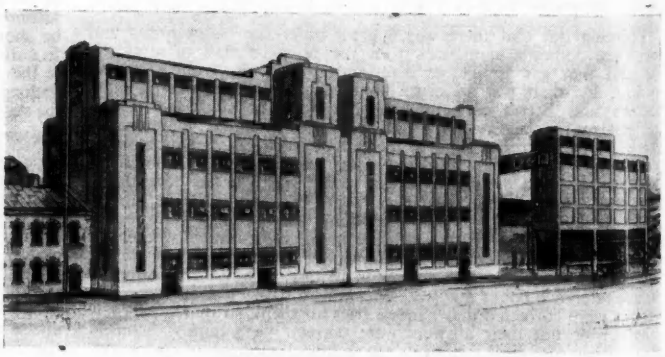


# GLOVER-WEST *Vertical Retorts at* COVENTRY

*"It is no longer considered necessary that the buildings housing Gas Works plant should be of a purely utilitarian character. For comparatively little extra expenditure it is possible for these buildings to be of such a character as to maintain and even raise the prestige of the Gas Industry in the eyes of the consumer and of the public as a whole."*

COMMUNICATION No. 230—PROCEEDINGS OF THE INSTITUTION OF GAS ENGINEERS, 1939-40.

**In this photograph of the fourth Installation of Glover-West Vertical Retorts at the Foleshill Works, Coventry, the coke storage hoppers with screening plant above are seen in the foreground. The retort house lies to the left. Space between is reserved for the duplication of the carbonizing plant. The project for the complete installation is sketched below.**



**West's Gas Improvement Co., Ltd.**

**Miles Platting, MANCHESTER 10**

Telephone: Collyhurst 2961-2-3-4-5.
Telegrams: Stoker, Manchester.

**London Office:**
**COLUMBIA HOUSE, ALDWYCH, W.C.2.**

Telephone: Holborn 4108-9.
Telegrams: WESGASCO, ESTRAND.

that they did maintain some goodwill. A solution which had been considered for some time, and which he believed was the right one, was to form a collective organization for servicing. That would be in the interests, not only of the suppliers of fuel, but also of the appliance manufacturers; it had been proposed that it should be financed and managed by the distributors and producers of solid fuel, and the appliance manufacturers.

Mr. G. VIVIAN DAVIES, dealing with the question as to whether service personnel should be all-round men or specialists, said that it was maddening to be told by a service man that he could not touch the refrigerator, for instance, because he knew nothing about it, and that the consumer must wait for another man to do it. He suggested that a great deal could be done by getting the service people experienced first in one form of appliance, and then switching them on to another, not only to relieve the monotony—and some servicing jobs could be quite monotonous—but in order that in time there would be a staff of highly skilled people. A service man should be regarded as a highly skilled man, and should be well paid for his work.

Mr. L. OLIVER questioned whether the problem of domestic servicing was such that it required the employment of specialists in particular appliances. Why a specialist in water heaters? He considered that there could be a specialist in domestic service engineering, who should be capable of dealing with all domestic appliances. Speaking as a heating engineer, Mr. Oliver said that in his profession they were capable of taking care of heating and cooking equipment of all sorts, including gas equipment. He could not agree with a scheme whereby all consumers had to pay a charge to cover maintenance, because some people looked after their equipment, and he did not see why they should pay for other people's faults.

Mr. W. JOHNSON, referring to servicing in factories, said that the direct method of charge was the only one to adopt. The man who ran a business for profit did not expect anything for nothing. The servicing of factories could be profitable, for it was very difficult for the smaller factories to employ maintenance people able to cover all the various services used; there was a very big field for profitable enterprise there. A factory manager was a specialist in his own line and, like everybody else, was always willing to farm out trouble. With regard to the problem of the specialist *versus* the all-round service man, he suggested that it was necessary to employ specialists if only because of trade union trouble. A gasfitter would not tackle the brick setting of a furnace, nor would he tackle the electrical controls. Therefore it was necessary to adopt specialization in some degree.

Dr. G. W. ANDERSON was sorry that the Paper had dealt only with domestic servicing, and pointed out that a good deal of service was given by contractors, though Mr. Roskill had not touched on it. The policy adopted by the Company to which the President had referred was by far the best; that principle of service after installation, which was adopted by many reputable firms in pre-war days, was right, and the service rendered was very valuable.

On the motion of the PRESIDENT, the thanks of the meeting were accorded Mr. Roskill; and the President suggested that he be asked to expand the Paper at some future date to cover a much wider field.

## Smoke Survey at Leicester

Listeners to the Home Service of the B.B.C. heard recently a talk on the damage caused by smoke in England by Professor J. M. Mackintosh, of the London School of Hygiene and Medicine. He outlined the work of the Department of Scientific and Industrial Research, who have carried out a survey of the conditions prevailing in Leicester.

Leicester was chosen principally because it is centrally placed in England and exceptionally well separated from other industrial towns It is roughly circular in shape, with its factory chimneys near the centre and its residential areas widely distributed. The air pollution has been measured by special instruments day and night at fifteen different points and at hourly intervals since 1937. The results show that, although the smokiest district in Leicester is in the centre, as might be expected, this is true whatever the speed and direction of the wind. The highest concentration shifts only half-a-mile down wind. Speaking of the broad agricultural belt surrounding the city, Prof. Mackintosh said that much of the smoke pollution comes from industrial areas as much as 60 miles away. Three-quarters of the smoke in central Leicester in winter comes from domestic chimneys, proving that open fires burn coal more wastefully. In fact, home fires make twice as much smoke per ton of coal as the industrial works. Cardiff, where smokeless fuel is commonly used, has only a quarter as much smoke as other cities of the same size.

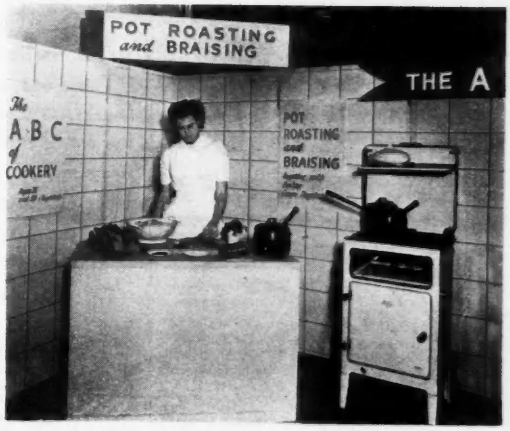
Referring to smokeless zones, he thought the results would not be spectacular. Tests made in Hyde Park show that it is only a quarter less smoky than the district round it. Since the material damage caused by smoke in England amounts to nearly £50,000,000 a year, it is obvious that some more drastic method is necessary. The only real cure is a complete reform in our methods of burning fuel—especially in the home.

## Imperial College Vacation Work

The eleventh annual report of the Vacation Work Committee to the Governors of the Imperial College of Science and Technology for the year ended October, 1945, states that the scheme during the past year not only maintained its service to the students of the College, but was compelled in some respects to widen its scope considerably. Many matters outside the terms of reference of the Committee had to be dealt with. While in 1941, 181 students were placed with 124 firms, &c., during the past year no less than 467 students were placed with 230 firms. This in itself gives some indication of the growth of the service.

As the scheme expanded it was inevitable that pressure would be exerted from outside firms and institutions to deal with matters formally outside the terms of reference of the Committee. Personnel Managers naturally tend to seek assistance from the contacts they have thus established in filling vacancies that arise in their firms, and it has been impossible for the Committee to refuse such assistance. Problems of the College training of students *vis-à-vis* the practical experience at the firms themselves have been raised. This has meant that questions more directly of interest to the teaching and research staff of the College have frequently been raised, and to provide a means for its ventilation the Committee held a conference on "Industry and University Education." Closely linked with this was the development of the system of I.C.U. leaflets, which provide schemes of practical work, and in which an effort has been made to encourage the pooling of experience in the different firms which co-operate. In some respects this interweaves with certain educational aspects of College work; but again such developments have been inevitable. More and more firms have tended to regard the vacation work Committee as their natural contact on all College work. They have raised such questions as Refresher Courses for their staffs, Apprenticeship Schemes that would link up with studies leading to University degrees, Graduate Apprenticeship Schemes. &c. These and numerous other enquiries of a like nature, while they have tended vastly to increase the work and scope of the Committee, have also helped to strengthen the bonds between College and Industry and to maintain a lively interest of each in the other.

Visits to works were undertaken during vacation by members of the Committee, and in this way a personal contact maintained with the staffs and the students while they were actually engaged on their duties. The Committee records its appreciation of the courteous welcome it has always received from the personnel of the industrial concerns visited.




*The Ministry of Food's recent production of "The A.B.C. of Cookery" was launched with a Press visit, followed by a demonstration session. "Easy as A.B.C." also describes the Regulo New World gas cooker seen on the right.*

**The Foundation Stone** of the first pair of Pudsey's thousand post-war houses to be built by the Corporation, all of which are to be serviced with gas, was laid on Dec. 21 by Alderman R. Ogden, Chairman of the Health and Housing Committee. The large company present of civic and contractors' representatives included Mr. J. Brooke. Secretary of the West Riding Group of Gas Companies, and Mr. H. B. Taylor, General Manager. The Mayor (Ald. G. P. Jackson) introduced Alderman Ogden, and presented to him a silver trowell, donated anonymously, as a memento. He referred appreciatively to the amicable co-operation between the various contractors and the Corporation, sentiments which were endorsed by Ald. Ogden. Ald. Ogden also mentioned that it was the first of approximately 400 houses which they hoped to complete on the Farfield Estate before the end of 1946. During the year they also intended to make a start on approximately 125 houses in the Calverley area, and in 1947 to commence a big estate at Crimbles, Pudsey.